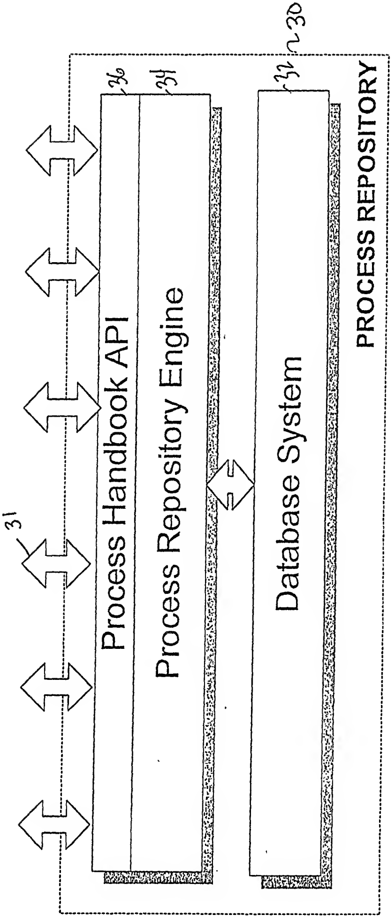
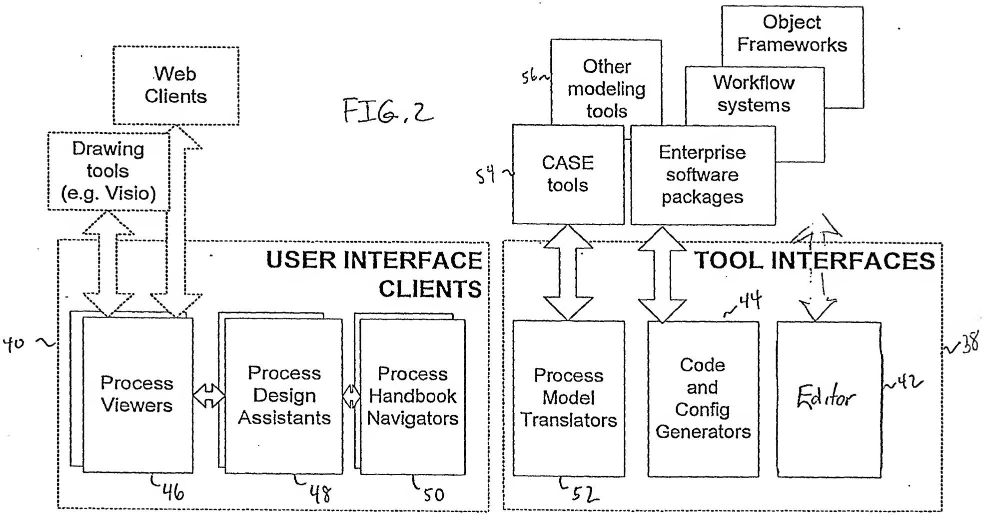

30
PROCESS REPOSITORY
36
Process Handbook API
34
Process Repository Engine
32
Database System
31

FIG. 1

FIG. 2


Web Clients
Drawing tools (e.g. Visio)
USER INTERFACE CLIENTS
Process Viewers
Process Design Assistants
Process Handbook Navigators
40
46
48
50
Other modeling tools
Object Frameworks
Workflow systems
CASE tools
Enterprise software packages
56
54
TOOL INTERFACES
Process Model Translators
Code and Config Generators
Editor
52
44
42
38

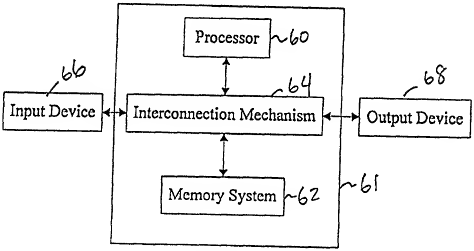

Processor
60
66
64
68
Input Device
Interconnection Mechanism
Output Device
Memory System
62
61

Fig. 3

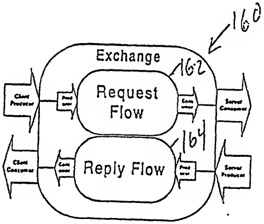

160
Exchange
162
Client Producer
Prod ucer
Request Flow
Con sumer
Server Consumer
164
Client Consumer
Con sumer
Reply Flow
Prod ucer
Server Producer

FIG. 5

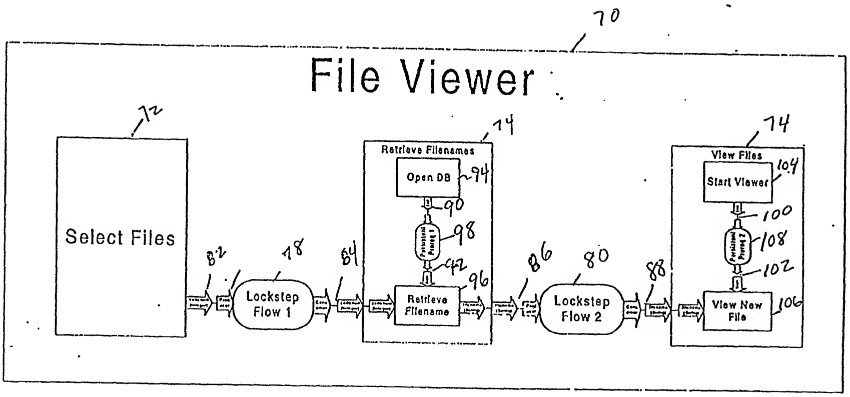

70
File Viewer
72
Select Files
82
78
Lockstep Flow 1
84
74
Retrieve Filenames
Open DB
94
90
98
Persistent Piping 1
92
Retrieve Filename
96
86
80
Lockstep Flow 2
88
74
View Files
Start Viewer
104
100
108
Persistent Piping 2
102
View New File
106

FIG. 4

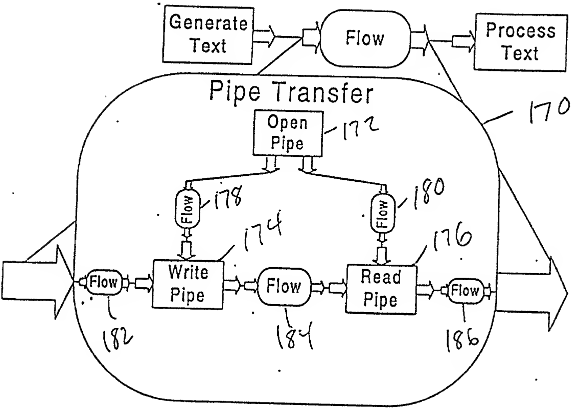


FIG. 6

FIG. 7(a)

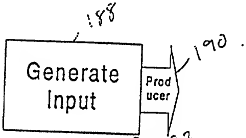
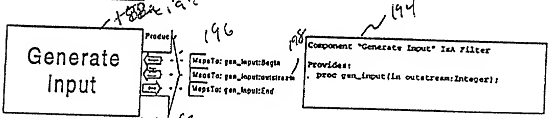
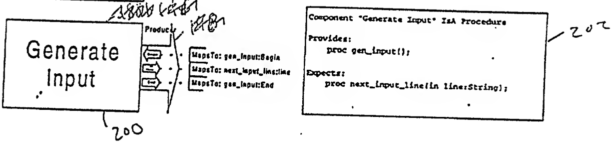


FIG. 7(b)



```
Component "Generate Input" IsA Filter

Provides:
. proc gen_input(in outstream:Integer);
```

FIG. 7(c)



```
Component "Generate Input" IsA Procedure

Provides:
    proc gen_input();

Expects:
    proc next_input_line(in line:String);
```

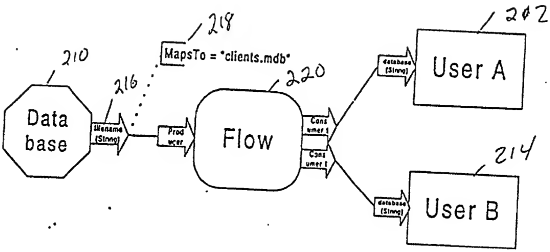

210
Data base
216
filename (String)
218
MapsTo = "clients.mdb"
Producer
220
Flow
Consumer 1
Consumer 1
202
database (String)
User A
214
database (String)
User B

FIG. 8

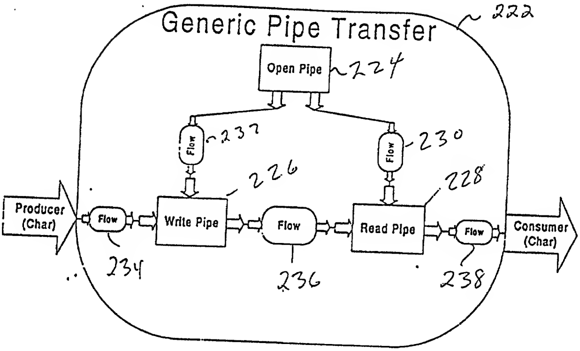

222
Generic Pipe Transfer
Open Pipe
224
Flow
232
Flow
230
226
228
Producer (Char)
Flow
Write Pipe
Flow
Read Pipe
Flow
Consumer (Char)
234
236
238

FIG. 9

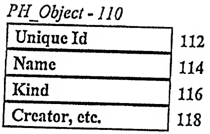


FIG. 10

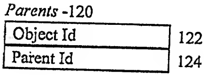


FIG. 11

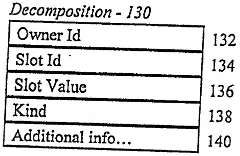


FIG. 12

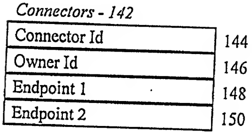
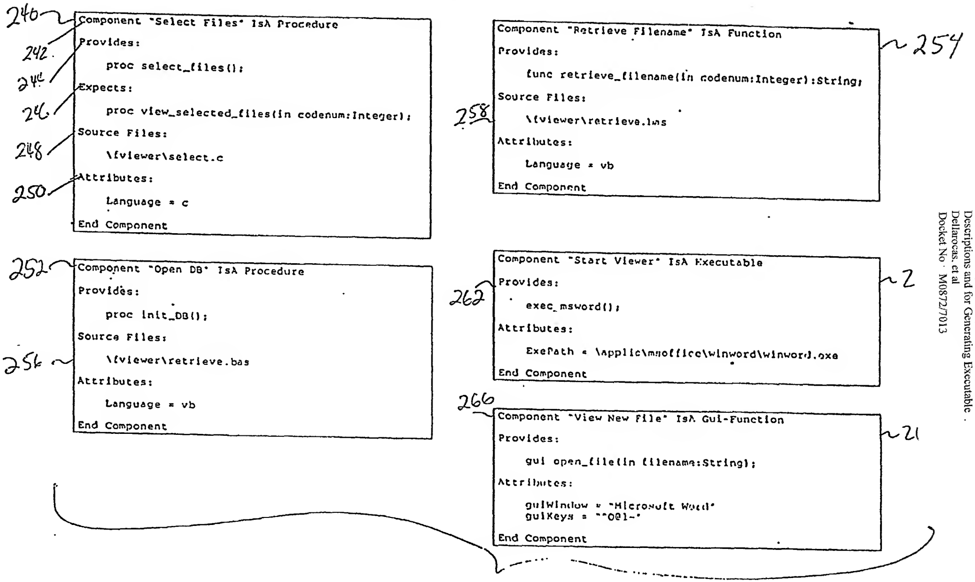


FIG. 13



```
Component "Select Files" IsA Procedure
Provides:
    proc select_files();
Expects:
    proc view_selected_files(in codenum:Integer);
Source Files:
    \fviewer\select.c
Attributes:
    Language = c
End Component
```

```
Component "Open DB" IsA Procedure
Provides:
    proc init_DB();
Source Files:
    \fviewer\retrieve.bas
Attributes:
    Language = vb
End Component
```

```
Component "Retrieve Filename" IsA Function
Provides:
    func retrieve_filename(in codenum:Integer):String;
Source Files:
    \fviewer\retrieve.lms
Attributes:
    Language = vb
End Component
```

```
Component "Start Viewer" IsA Executable
Provides:
    exec_msword();
Attributes:
    ExePath = \applic\msoffice\winword\winword.exe
End Component
```

```
Component "View New File" IsA Gui-Function
Provides:
    gui open_file(in filename:String);
Attributes:
    guiWindow = "Microsoft Word"
    guiKeys = "^O@1~"
End Component
```

FIG. 14

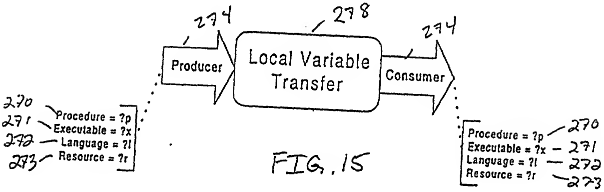


FIG. 15

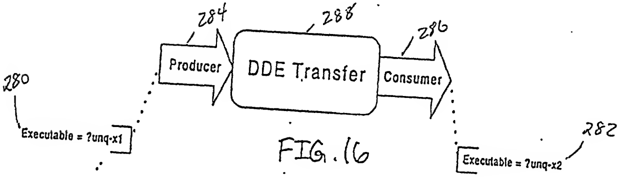


FIG. 16

FIG. 18

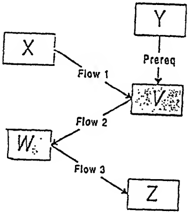
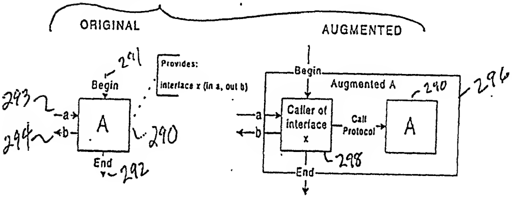
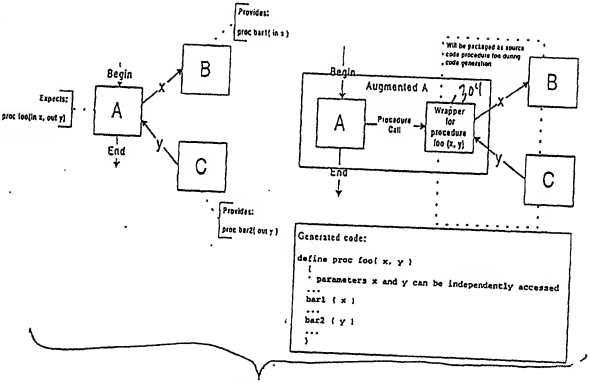


FIG. 19



```
Check_Compatibility( aport, dport )
--              aport = activity port
--              dport = dependency port
-- Returns:      SUCCESS if ports can be legally connected, FAILURE otherwise
-- Uses:        Match_Values( va, vd )

460 - If one port is composite and the other is atomic then return FAILURE.

462 - If both ports are composite then recursively match subports.

464 - If both ports are atomic then
       If aport is same as or a specialization of dport then
              For each attribute defined at both ports (including inherited attributes)
                     If both ends have a value then  call Match_Values
              472    else If one end refers to a variable then
                            If variable has a value then call Match_Values
                            else   Set variable and its equivalence class to value at other end
              470 -                Return SUCCESS.
                     else If both ends refer to variables
                            If one or both variables have values then do as above.
                            If no variable has a value then
                     474 -         Unify both variables into an equivalence class
                                   Return SUCCESS.
466 -   else return FAILURE.

468:
Match_Values( va, vd )
--              va = value of attribute at activity side
--              vd = value of attribute at dependency side
-- Returns:     SUCCESS if values match, FAILURE otherwise.

 If values are identical then return SUCCESS.
 If values are pointers to language elements then

476 -   If va is a specialization of vd*
               then return SUCCESS.
        *Exception: when comparing resources of consumer ports the opposite specialization relationship
must hold.
 Return FAILURE
```

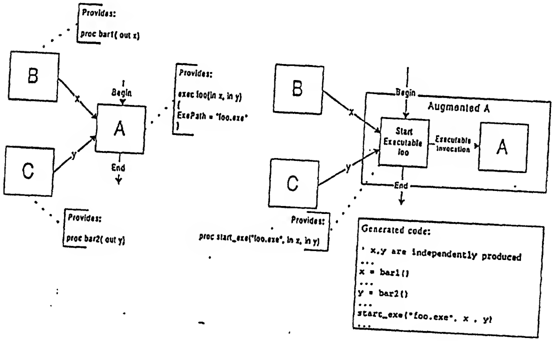
Fig. 17



Generated code:

```
define proc foo( x, y )
 {
 * parameters x and y can be independently accessed
 ...
 bar1 ( x )
 ...
 bar2 ( y )
 ...
 }
```

FIG. 20



Generated code:

```
 * x,y are independently produced
...
x = bar1()
...
y = bar2()
...
start_exe("foo.exe", x , y)
...
```

FIG. 21

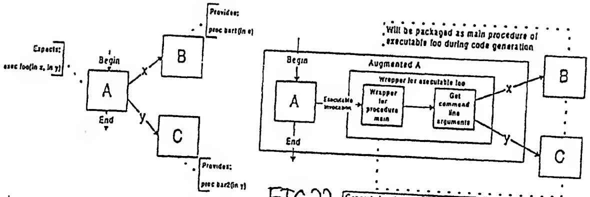


FIG.22

```
Generated code:

* argv is operating-system-specific structure
* containing command line parameters
define proc main(argv)
  {
  ...
   * get_args leaves command line parameters
   * to variables x and y
  get_args(argv, x, y)
  ...
  bar1( x )
  ...
  bar2( y )
  }
```

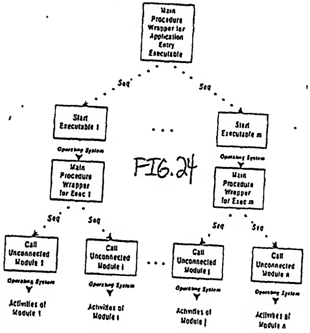


FIG.24

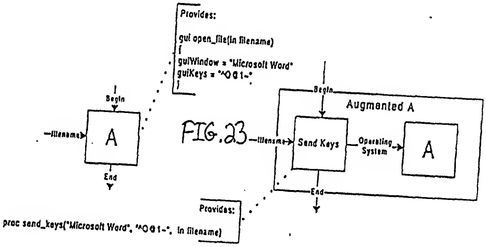


FIG.23

*Input:* A diagram consisting of activities and dependencies
*Output:* A set of executable files implementing the target application

330. Decouple interface dependencies
332. Specialize generic design elements
334. Connect all modules to control
336. Generate executable code

Fig. 25

```
338 -  Recursively scan all activities in the application graph.
       For every activity associated with a code-level component,
340 -      Scan all provided and expected interface definitions of the associated component.
               For every provided interface,
342 -              Get the interface kind.
                   If a caller activity has been defined for that interface kind,
344 -                  Check for "perfect match" special cases
                       If no "perfect match" interface is found at the other end,
346 -                      Replace the original primitive activity with a composite
                           pattern that includes a caller activity.
               For every expected interface,
348 -              Get the interface kind.
                   If a wrapper activity has been defined for that interface kind,
350 -                  Check for "perfect match" special cases
                       If no "perfect match" interface is found at the other end,
352 -                      Replace the original primitive activity with a composite
                           pattern that contains a wrapper activity.
```

Fig. 26

Computer System and Computer Implemented
Process for Representing Software System
Descriptions and for Generating Executable .
Dellarocas, et al
Docket No.. M0872/7013

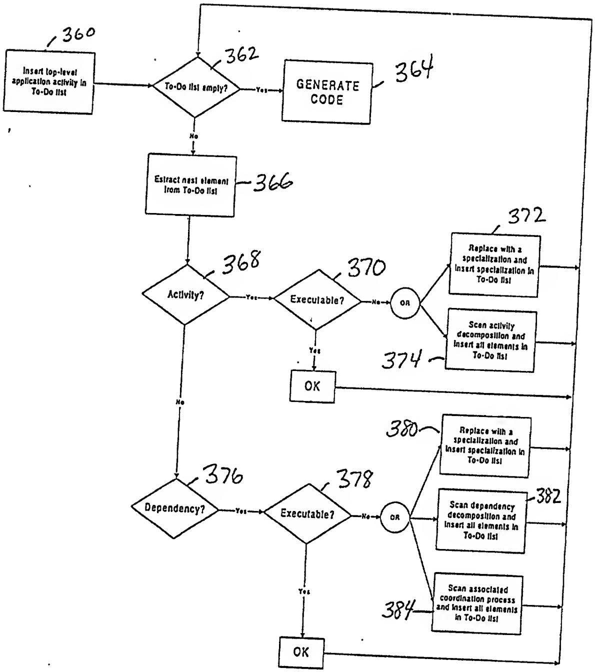


FIG. 27

```
390: Scan graph and build a to-do list containing,
        - all generic atomic activities (i.e. atomic activities not associated with a code-level component)
        - all unmanaged dependencies

      Repeat the following two operations until to-do list becomes empty,
392:a.  Extract the next generic atomic activity.
        For each executable specialization of that activity stored in the design repository,
396         Apply the compatibility checking algorithm
398         If at least two matching executable specializations are found,
                Ask user to select between them.
            Otherwise,
                Repeat while user input is invalid:
400                 Ask user to provide a specialization for the activity.
                    Check validity of user-supplied activity (if must pass the compatibility
                    checking algorithm and either be atomic and executable or composite
402             Permanently store new activity in the repository.
        Replace generic activity with selected or user-supplied specialization.
406     Apply Stage 1 of the algorithm to the replacing activity.
        If replacing activity is composite and generic,
408         Scan activity decomposition and add all generic atomic activities and unmanaged
            dependencies found to the to-do list

394:b.  Extract the next unmanaged dependency
        For each coordination process* associated with a specialization of that dependency stored in the
        design repository,
410         Apply the compatibility checking algorithm.
            If at least two matching coordination processes are found,
412             Ask the user to select among them.
            Otherwise,
                Repeat while user input is invalid:
414                 Ask user to provide a compatible coordination process.
416                 Check validity of user-supplied process (it must pass the compatibility
                    checking algorithm and either be atomic and executable or composite)
418             Permanently store new process in the repository.
420         Manage dependency with the selected or user-supplied coordination process.
422         Apply Stage 1 (Fig. 26) of the algorithm to the managing coordination process.
            If managing coordination process is composite,
424             Scan process decomposition and add all generic atomic activities and unmanaged
                dependencies found to the to-do list.
```

* The term coordination process here also includes atomic software connectors associated with executable dependencies.

Fig. 28

430. Scan the application graph and find all source modules that are not connected to a source of control.
432. Introduce a set of *packaging* executable components, one per host machine and per language for which unconnected source modules exist.
434. Package calls to unconnected source modules inside the main program of the packaging executable corresponding to the host machine and language of each module.
436. Scan the application graph and find all executable programs that are not connected to a source of control.
438. Introduce an *application entry* executable component into the system.
440. Package invocation statements for all unconnected executables inside the main program of the application entry component.

Fig. 29

```
442   Scan graph and divide into sequential block subgraphs*.
         For each subgraph,
444            Topologically order activities according to their sequentialization interdependencies.
446            Generate a call statement for each activity.
448            Generate a local variable declaration for each local variable coordination process.
450            Generate appropriate headers and footers for the enclosing sequential block.
452            Save resulting sequential block code into a file.

      For each target executable:
454            Collect all source and object files of the executable**.
456            Compile files and place resulting executable into target application directory.
```

* Sets of activiteis that will be packaged in the same sequential code block.

**The files are (1) all source and object files referenced in the component descriptions of all activities to be included in the executable, and (2) all coordination code source files generated by step 442 for the target executable.

Fig. 30

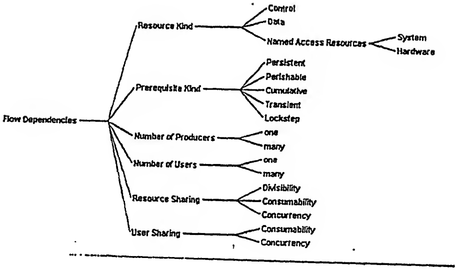

Flow Dependencies
Resource Kind
Control
Data
Named Access Resources
System
Hardware
Prerequisite Kind
Persistent
Perishable
Cumulative
Transient
Lockstep
Number of Producers
one
many
Number of Users
one
many
Resource Sharing
Divisibility
Consumability
Concurrency
User Sharing
Consumability
Concurrency

FIG. 31

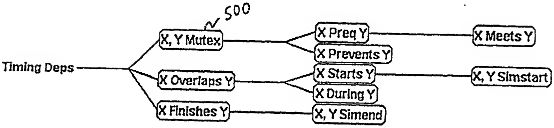

500
Timing Deps
X, Y Mutex
X Overlaps Y
X Finishes Y
X Preq Y
X Prevents Y
X Starts Y
X During Y
X, Y Simend
X Meets Y
X, Y Simstart

FIG. 32